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II. Solution by G. W. GREENWOOD, M. A. (Oxon), Lebanon, Ill.

Since P and D are extremities of conjugate diameters, their coördinates may be written $(a\cos\phi, b\sin\phi)$, $(a\sin\phi, -b\cos\phi)$ where a and b are the semi-axes. We obtain the required result at once by disregarding the sign and considering only the absolute magnitudes of the coördinates. Equations to AP and BD are

$$\frac{x-a\cos\phi}{a-a\cos\phi} = \frac{y-b\sin\phi}{-b\sin\phi}, \text{ and } \frac{x-a\sin\phi}{-a\sin\phi} = \frac{y+b\cos\phi}{b+b\cos\phi},$$

and the inclinations are therefore

$$-\frac{b\sin\phi}{a(1-\cos\phi)} \text{ and } -\frac{b(1+\cos\phi)}{a\sin\phi},$$

which are easily seen to be equal.

Also solved by G. B. M. Zerr.

CALCULUS.

187. Proposed by L. T. JACKSON, St. Louis, Mo.

Find the area of the ellipse

$$\begin{aligned} x &= a_1 + a_2 \cos\theta + a_3 \sin\theta, \\ y &= b_1 + b_2 \cos\theta + b_3 \sin\theta. \end{aligned}$$

I. Solution by H. B. LEONARD, B. S., Chicago, Ill.

Let $x' = x - a_1$, $y' = y - b_1$; then eliminating $\cos\theta$ and $\sin\theta$ in turn we obtain

$$b_2 x' - a_2 y' = \Delta \sin\theta, \quad b_3 x' - a_3 y' = -\Delta \cos\theta,$$

where $\Delta = b_2 a_3 - a_2 b_3$. The substitution $x'' = b_2 x' - a_2 y'$, $y'' = b_3 x' - a_3 y'$, which multiplies areas by Δ , transforms the ellipse into the circle $x'' = \Delta \sin\theta$, $y'' = -\Delta \cos\theta$; i. e. $x''^2 + y''^2 = \Delta^2$.

The area of circle being $\pi \Delta^2$, the area of ellipse is $\pi \Delta = \pi(b_2 a_3 - a_2 b_3)$.

II. Solution by G. B. M. ZERR, A. M., Ph. D., Parsons, W. Va.

Transform the origin to the center by writing x for $x - a_1$, y for $y - b_1$.

$$\therefore x = a_2 \cos\theta + a_3 \sin\theta, \quad y = b_2 \cos\theta + b_3 \sin\theta.$$

$$\text{Area} = \int y dx = \int_0^{2\pi} (b_2 \cos\theta + b_3 \sin\theta)(a_2 \cos\theta - a_3 \sin\theta) d\theta$$

$$= \int_0^{2\pi} (a_3 b_2 \cos^2\theta - a_2 b_3 \sin^2\theta - a_2 b_2 \sin\theta \cos\theta \pm a_3 b_3 \sin\theta \cos\theta) d\theta$$

$$= \pi(a_3 b_2 - a_2 b_3).$$

Also solved by F. P. Matz, and the Proposer.